REMARKS

As the advantages of metal halide lamps have become commercially appreciated, there has been an increased demand for a highly efficient and economical metal halide lamps with long lasting arc tubes. Use of an arc tube having a slim, elongated shape provides advantages in the efficient outputting of an emission spectrum of light. These advantages, however, come at a cost because such thin tubes can be subject to a relatively high temperature change rate as heat can be easily applied and easily removed, thereby creating the potential of a large thermal shock that can produce cracks and thereby shorten the life of the arc tube.

As attested to by the prior art references applied, relatively large sophisticated companies with skilled engineers and scientists are involved in this highly competitive business and improvements that can provide a competitive edge, such as increased life for the arc tube, can be significant in this field.

The present application sets forth the efforts undertaken by the present inventors to provide the present invention, see Page 4, line 2 to Page 5, Line 8 of our patent specification, wherein a crystal grain diameter of G(μm) satisfies the following range:

$$0.5 \leq G \leq 1.5$$

The Office Action contended that claims 1-3 and 5-9 were unpatentable over a combination of the Keijser et al. US Patent No. 6,300,729 in view of the Kurashina US Patent Publication 2002/0155944 when further taken in view of the Watanabe et al. US Patent No. 6,482,761.

The Office Action acknowledged that the Keijser et al. reference did not address nor teach 200 ppm or lower amounts of magnesium oxide nor an average crystal grain diameter of polycrystalline alumina ceramic of the desired size. The Office Action relied upon the

Kurashina reference for showing a polycrystalline alumina and more specifically referred to Paragraph 12 in the specification for a purported teaching of an average grain size in the range of 5 μm to 50 μm.

Actually, the Kurashina et al. reference was concerned with the difficulty of alumina polycrystals to obtain a linear transmittance of not less than 8%.

With regards to teaching an average grain size, it is noted in Paragraph 0033 that the grain orientation rate and average grain size of the sintered compact was found to be 28 μm which could be achieved by starting with an α-alumina powdery material of plate-like crystalline particles with an average grain size of 0.5 μm mixed with water and 250 parts ppm of magnesium oxide powders to form a slurry which is then subsequently subject to crushing within a pot mill for 20 hours. The slurry product is then molded and compacted and calcinated at a temperature of 850°C. See Paragraph 0029. The pre-form product is subsequently chelated and then further calcinated at 1200°C and finally is sintered at 850°C. Thus, the final sintered ceramic polycrystal product has an average grain size of 28 μm.

The Office Action did not recognize the express limitations associated with a concern for double refraction in a ceramic polycrystal as noted on Paragraph 0014. In this regard, problems of double refraction increase remarkably when the average grain size becomes less than 5 μm and as a result there is a decrease in the linear transmittance of the ceramic polycrystalline. This is the actual problem addressed by the Kurashina et al. reference, namely to increase the linear transmittance and accordingly this reference would teach away from a final sintered ceramic polycrystal of less than 5 μm.

> [I]t is generally settled that the change in prior art device which makes the device inoperable for its intended purpose cannot be considered to be an obvious change.

> *Hughes Aircraft Co. v. United States*, 215 U.S.P.Q. 787, (Ct.Cl. Trial Div. 1982)

The Watanabe et al. US Patent No. 6,482,761 was cited for its teaching of a polycrystalline alumina with an average grain size of 5 to 50 μm. More specifically, the teaching relied upon states as follows:

> Further, the average grain size of the alumina sintered body is preferably 5 μm or more to 50 μm or less.

A close review of the remaining portions of the Watanabe et al. specification simply describes that it is important to provide a sufficient amount of magnesium oxide to suppress abnormal grain growth and resulting large pores which impact on the light transmissivity of the resulting tube. Thus, a series of Examples 1-7 are summarized in a Table on Column 13 and from each of the examples it can be seen that an initial selection of a particular grain or initial alumina powder was designed to produce a translucent alumina centered body while addressing abnormal grain growth and large pore sizes. As can be seen from Table 1, the actual average grain size was approximately 36 μm with Example 2 being at 40 μm. The transmittance ranged from 40% to 64%.

Thus, the initial green primary particle sizes were selected, as set forth on Column 3, lines 10-17, in a range of 0.3 μm to 0.7 μm. These are the particles that are used to prepare the slurry and purportedly by having a small range of particle size distribution in the slurry, that is a control particle size with a relatively high purity, it will address the pore problems that can be developed when the grains are subsequently heated to high temperatures to create a final sintered body under controlled pressure and temperature conditions. See Column 3, lines 31-43.

It should be appreciated, from the teaching in the Watanabe et al. reference, that by selecting in the slurry a relatively uniform grain size, that a desired sintered crystalline grain size would be approximately 36 μm in the finished product.

This teaching is also consistent with the Kurashina et al. description of Paragraph 0028 which was relied upon on Page 5 of the Office Action to purportedly teach a crystal grain diameter (μm) of the polycrystalline alumina ceramic to satisfy the equation $0.5 \leq G \leq 1.5$.

Actually, Paragraph 0028 cites a conventional initial raw average grain size of the 0.5 μm in a slurry or a green pre-fired condition. A proper reading of Paragraphs 0029 through 0033 discloses that the average grain size in the slurry produces a grain growth at high temperatures which, in the case of the Kurashina et al. reference, becomes 28 μm in the final product. Thus, applicant respectfully traverses the interpretation of these references.

As noted in the recent Supreme Court case of KSR Int'l Co. v. Telefex, Inc.,

> Often, it will be necessary...to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit. *KSR,* slip op. at 14 (emphasis added).
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> *KSR Int'l Co. v. Teleflex, Inc.,* Supreme Court Case No. 04-1350 (U.S. April 30, 2007)

Thus, in looking at the three teachings relied upon to create the obviousness rejection, it becomes readily apparent that an objective evaluation and analysis will disclose that these references teach away from the present invention in a relatively crowded field. The lynch pin for this rejection is an apparent misunderstanding that the claimed crystal grain diameter is not the

green or slurry raw powder composition but is rather the final crystal grain diameter that will exist in the sintered or fired ceramic arc tube.

The present inventors have discovered, with much effort, that they can effectively prevent cracks and improve resistance against thermal shocks by adjusting the final crystal grain diameter G(μm) of the fired polycrystalline alumina ceramic for at least the main tube part if it satisfies the condition $0.5 \leq G \leq 1.5$ wherein the final diameter is clearly much smaller than that of the teachings of the conventional art cited in the Office Action rejection.

As a result of the present invention, even if the main tube part is made long and thin to improve the luminous efficiency, cracks can be substantially reduced with an increase in the life expectancy of the metal halide lamp. This is accomplished while still increasing a luminous flux transmittance of the arc tube.

The Office Action's reliance upon Paragraph 0028 of the Kurashina teaching does not support a grounds for rejection of our current claims.

Paragraph 0028 only discloses that the α-alumina powdery material that has not been fired comprises plate-like crystalline particles with an average grain size of 0.5 μm. Paragraphs 0012 and 0025 of the Kurashina et al. reference and Column 2, lines 58-59 of the Watanabe et al. reference disclose that the average crystal grain diameter of the fired alumina ceramic is within a range from 5 μm to 50 μm, which is far different from the present invention.

Generally, it is known that alumina particles undergo sintering and grain growth due to firing, which means that the sizes of the grain diameter will increase. The extent of the grain growth depends on the sintering temperature, the atmosphere, the pressure and so on.

The present invention improves the thermal resistance of the main tube part and realizes a lamp having a higher luminous flux transmittance and a longer life by forming the main tube part

with an alumina ceramic wherein the crystalline grain diameter of the fired polycrystalline alumina ceramic satisfies $0.5 \leq G \leq 1.5$. Such characteristic structure and effects of the present invention are not disclosed by any of the Kurashina, Watanabe et al. and Keijser references.

The features of the present invention are set forth in each of the independent claims 1 and 6. The dependent claims add additional novelty features.

Therefore, even if it is possible to combine the teachings of the above mentioned references, the present invention possesses an inventive feature over the combination of these references because none of the references disclose the characteristic structure of the present invention.

Accordingly, it is believed that the case is now in condition for allowance.

If the Examiner believes a telephone interview will help further the prosecution of this case, the undersigned attorney can be reached at the listed phone number.

Very truly yours,

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